

What is claimed is:

1. A waveguide comprising
a first optically transmissive material that forms an interface with a second
5 optically transmissive material, wherein the refractive index of said second material is
greater than or equal to the refractive index of said first material; and
one or more populations of scattered light detectable particles of a dimension
between about 1 and about 500 nm inclusive that are bound to an analyte, wherein said
particles are distributed in said second material such that said particles are illuminated
10 by non-evanescent light and produce detectable scattered light in said waveguide.
2. The waveguide of claim 1, wherein each population of particles binds to
a different predetermined analyte, and has a particle type configuration distinguishable
from other populations by its predetermined scattered light detectable property.
3. The waveguide of claim 1 or 2, wherein said particles comprise a metal,
15 a metal compound, a semiconductor, or a superconductor.
4. The waveguide of claim 1 or 2, wherein said particles comprise gold,
silver, or both gold and silver.
5. The waveguide of claim 1 or 2, wherein said particles exhibits plasmon
resonant light scattering.
- 20 6. The waveguide of claim 1 or 2, wherein said one or more populations of
particles are separately spherical, non-spherical, symmetric, asymmetric, ellipsoidal,
cylindrical, cubical, tetrahedral, polyhedral, or pyramidal.
7. The waveguide of claim 1 or 2, wherein said particles are of a dimension
in the range of about 10 to about 200 nm inclusive, about 20 to about 200 nm inclusive,
25 about 40 to about 120 nm inclusive, about 80 to about 120 nm inclusive, about 1 to
about 10 nm inclusive, about 11 to about 40 nm inclusive, about 100 to about 250 nm
inclusive, or about 40 to about 80 nm inclusive.

8. The waveguide of claim 1 or 2, wherein said particles form aggregates, and wherein light scattered by said aggregates is detectably different from light scattered by individual particles.

9. The waveguide of claim 1 or 2, wherein said particles are bound to a probe that binds said analyte directly.

10. The waveguide of claim 1 or 2, wherein said particles are indirectly bound to said analyte via a probe and one or more members of at least one secondary binding pair.

11. The waveguide of claim 10, wherein said secondary binding pair comprises an antigen, a hapten, a polyclonal antibody, a monoclonal antibody, a lectin, a carbohydrate, a polynucleotide, a receptor, biotin, avidin, streptavidin, digoxigenin, or fluorescein.

12. The waveguide of claim 1 or 2, wherein said analyte is a polynucleotide, a DNA molecule, a RNA molecule, a PNA molecule, a polypeptide, a carbohydrate, a glycoprotein, a lipid, a glycolipid, a combinatorially-synthesized molecule, a natural product, a pharmaceutical agent, a chromosome, a cell organelle, a virus, a bacterium, a protozoan, a fungus, a pathogen, a microorganism, a single cell organism, or a cell of a multicellular organism.

13. The waveguide of claim 1 or 2, wherein one or more surfaces of said waveguide are adapted to couple light into said waveguide.

14. The waveguide of claim 1 or 2, wherein one or more surfaces of said waveguide is coupled to a prism, is coupled to an optical grating, or is coated with a reflective material.

15. The waveguide of claim 1 or 2, wherein one or more surfaces of said waveguide are adapted to couple scattered light from said waveguide to a sensor or an eyepiece.

16. The waveguide of claim 1 or 2, wherein said first material and second material separately comprise glass, quartz, silicon dioxide, silica, borosilicate, barium silicate, calcium fluoride, magnesium fluoride, a polystyrene, a polycarbonate, a

polyvinyl chloride, a polyvinyl alcohol, a polyethylene, a polytetrafluoroethylene, a perfluoroalkoxy, a polyvinylidene fluoride, an acrylate, a polyurethane, beta-pinene, a polyolefin, a cyclic olefin, cellulose acetate butyrate, benocyclobutene, a polysulfone, a polyester, a polyimide, a siloxane, an epoxide, a metal oxide, a silicon alkoxide, or a titanium alkoxide.

17. The waveguide of claim 1 or 2, wherein said first material is configured to form a first layer and said second material is configured to form a second layer that interfaces with said first layer to form a planar structure.

18. The waveguide of claim 17, wherein said first layer is configured to comprise one or more spatially addressable sites.

19. The waveguide of claim 17, wherein said particles are deposited on the surface of said first layer that forms said interface with said second layer.

20. The waveguide of claim 17, wherein said first layer is sandwiched by said second layer, and a third layer which comprises said second optically transmissive material.

21. The waveguide of claim 17, wherein said second layer is a coating that is applied to said first layer.

22. The waveguide of claim 17, wherein said first layer comprises silica and said second layer comprises an acrylate, a polyurethane, a polyvinyl alcohol, or beta-pinene.

23. The waveguide of claim 17, wherein said first layer is a slide, and one or more edges of said slide are adapted to couple light into said waveguide.

24. A method for detecting an analyte in a sample comprising the steps of:

(a) contacting said sample with one or more populations of scattered light detectable particles that bind to said analyte, wherein said particles are of a dimension between 1 and 500 nm inclusive;

(b) forming a planar waveguide comprising an interface between a first optically transmissive layer and a second optically transmissive layer, wherein said particles are

present in said second layer, and wherein the refractive index of said second layer is greater than or equal to the refractive index of said first layer;

(c) illuminating said particles in said waveguide with non-evanescent light under conditions which produces scattered light from said particles; and

5 (d) detecting light scattered by (i) said populations of particles bound with analyte; or (ii) said populations of particles not bound with analyte; or (iii) both (i) and (ii), as a measure of the presence of said analyte in said sample.

25. The method of claim 24, comprising prior to said contacting step, depositing either said sample, said particles, or both said sample and said particles on a
10 surface of said first optically transmissive layer.

26. The method of claim 24, wherein the step of forming said waveguide comprises contacting said first optically transmissive layer with a precursor of said second optically transmissive layer which is in liquid phase or gaseous phase.

27. The method of claim 24, wherein the step of forming said waveguide
15 comprises curing said second optically transmissive layer.

28. The method of claim 24, further comprising the step of depositing said particles on a surface of a first optically transmissive layer prior to forming said waveguide, such that said particles are present at said interface.

29. The method of claim 24, further comprising the step of distributing said
20 particles in said second optically transmissive layer or a precursor of said second optically transmissive layer, prior to forming said waveguide.

30. The method of claim 24, wherein said illuminating produces scattered light from said particle and in which light scattered from one or more said particles can be detected by a human eye with less than 500 times magnification and without
25 electronic amplification.

31. The method of claim 24, wherein said illuminating comprises illuminating said particles with monochromatic light, polychromatic light, white light, sunlight, or laser light.

32. The method of claim 24, wherein said illuminating comprises coupling incident light from a light source into said waveguide at an angle that creates total internal reflection at one or more exterior surfaces of said waveguide but not at said interfaces of said first layer and said second layer.

5 33. The method of claim 24, wherein said illuminating comprises coupling incident light from a light source to said first layer of said waveguide.

34. The method of claim 24, wherein said illuminating is provided by one or more light emitting diodes that are focused with one or more optical elements along an edge of said waveguide.

10 35. The method of claim 24, wherein said detecting comprises magnification with a microscope 2 to 500 times or 10 to 100 times.

36. The method of claim 24, wherein said detecting comprises providing an integrated light intensity measurement, particle counting, or both.

15 37. The method of claim 24, wherein said detecting comprises (i) forming an image, and (ii) viewing said image, recording said image, analyzing said image by a computer, counting particles in said image, or a combination of the foregoing.

38. The method of claim 24, wherein said detecting comprises use of a film camera, a video camera, confocal microscopy, a photodiode, a photodiode array, a photomultiplier tube, a CMOS, or a charge-coupled device.

20 39. The method of claim 24, wherein said illuminating step comprises providing incident light that is non-polarized, polarized, pulsed, constant, coherent, or noncoherent.

25 40. The method of claim 24, wherein said illuminating step comprises use of light from a filament lamp source, an arc lamp, a discharge lamp source, a laser, or a light emitting diode.

41. An apparatus for illuminating a planar waveguide and detecting scattered light produced by scattered light detectable particles in said waveguide, comprising:

a planar waveguide in a holder adapted to hold said waveguide;

an illumination system comprising a light source directed at said waveguide;
and

a scattered light detection system cooperating with said holder and illumination system to detect light scattered from said particles,

5 wherein said waveguide comprises a first optically transmissive layer that forms an interface on at least one side with a second optically transmissive layer, such that scattered light detectable particles in said waveguide are illuminated by non-evanescent light.

10 42. The apparatus of claim 41, wherein said illumination system further comprises one or more optical elements such that light from said light source is directed at a target surface of said waveguide at an angle that creates total internal reflection at one or more exterior surfaces of said waveguide but not at said interfaces of said first layer and said second layer.

15 43. The apparatus of claim 41, wherein said holder comprises X and Y stages for precisely positioning said waveguide with respect to said illumination system and said detection system.

20 44. The apparatus of claim 41, wherein said illumination system comprises a plurality of light emitting diodes focused on a target surface of said waveguide.

25 45. The apparatus of claim 41, wherein said detection system comprises an eyepiece, a film camera, a video camera, a photomultiplier, a photodiode, a photodiode array or a charge coupled device.

30 46. The apparatus of claim 41, wherein said illumination system comprises a broad-band light source and said apparatus further comprises a plurality of individually selectable spectrally discriminative light filters disposed in at least one of the illumination system or detection system.

47. The apparatus of claim 41, wherein said illumination system comprises a light source and cylindrical lens configured to focus a line of light along an edge of said first layer of said waveguide.

5 48. The apparatus of claim 41, wherein said detection system comprises light detector focused on a surface of said waveguide proximate to said second layer, and defines a field of view extending from said surface, into said second layer of said waveguide and terminating at or before said interface with said first layer.